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SOME CONCEPTS ON THE USE OF DEFLECTION MEASUREMENTS FOR EVALUATING FLEXIBLE PAVEMENTS

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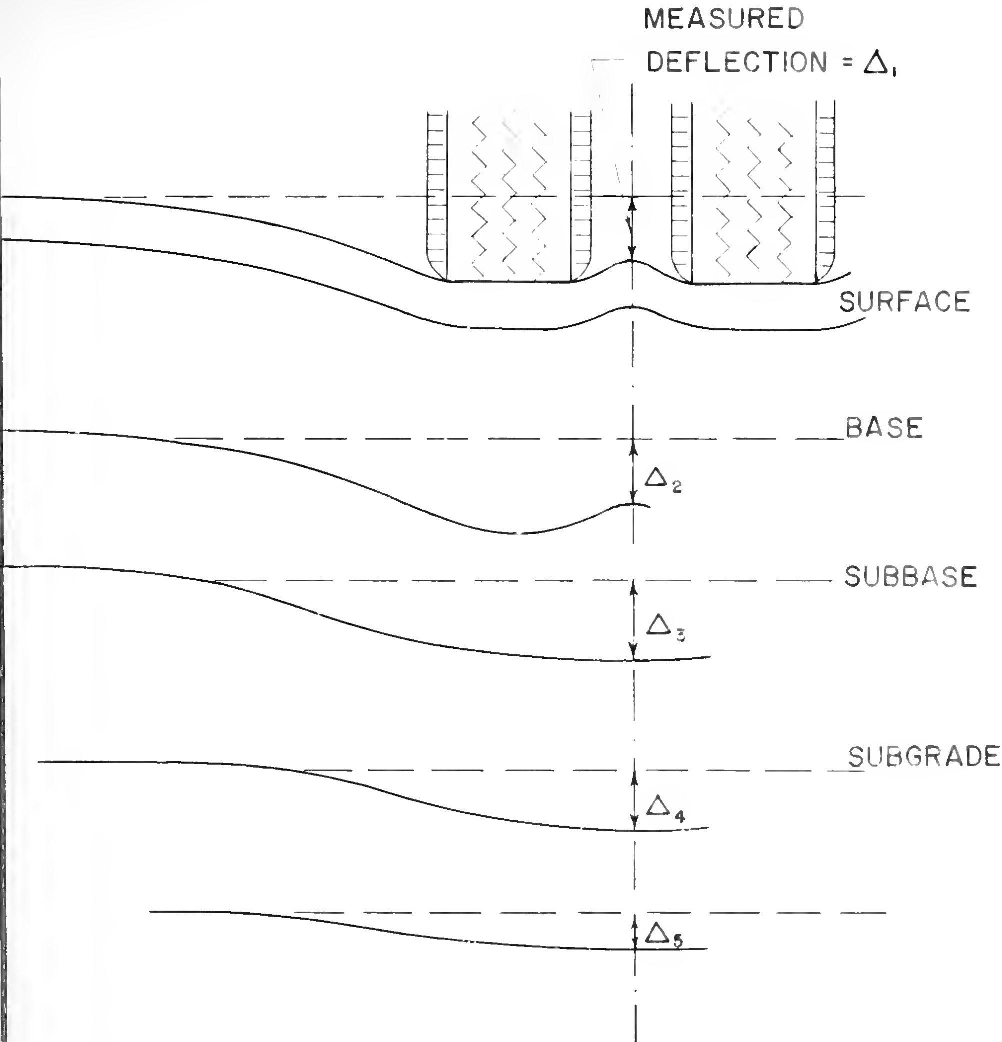
LIST OF FIGURES

pavement stresses and deflections to the applied load. Certain simplify- [illegible]



DEFLECTION PROFILES

FIGURE 1

Pavement distress as evidenced by rutting, cracking, etc. can be caused by [illegible] distress [illegible] consider the [illegible] in Figure 1. It is noted that shoving between the wheels would cause [illegible] to form [illegible], or an effect that [illegible] [illegible]

[illegible]

[illegible] should not be the result.

[illegible]

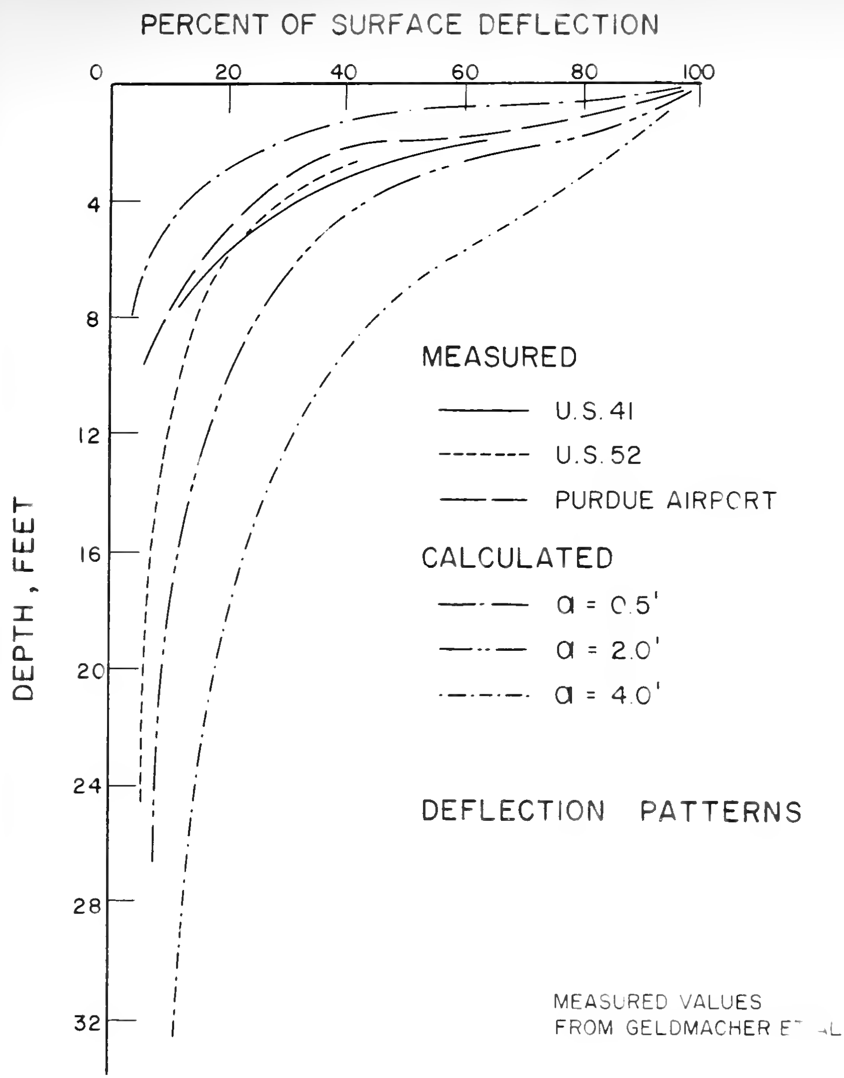

PERCENT OF SURFACE DEFLECTION
0
20
40
60
80
100
4
8
12
16
20
24
28
32
DEPTH, FEET
MEASURED
U.S. 41
U.S. 52
PURDUE AIRPORT
CALCULATED
a = 0.5'
a = 2.0'
a = 4.0'
DEFLECTION PATTERNS
MEASURED VALUES
FROM GELDMACHER ET AL

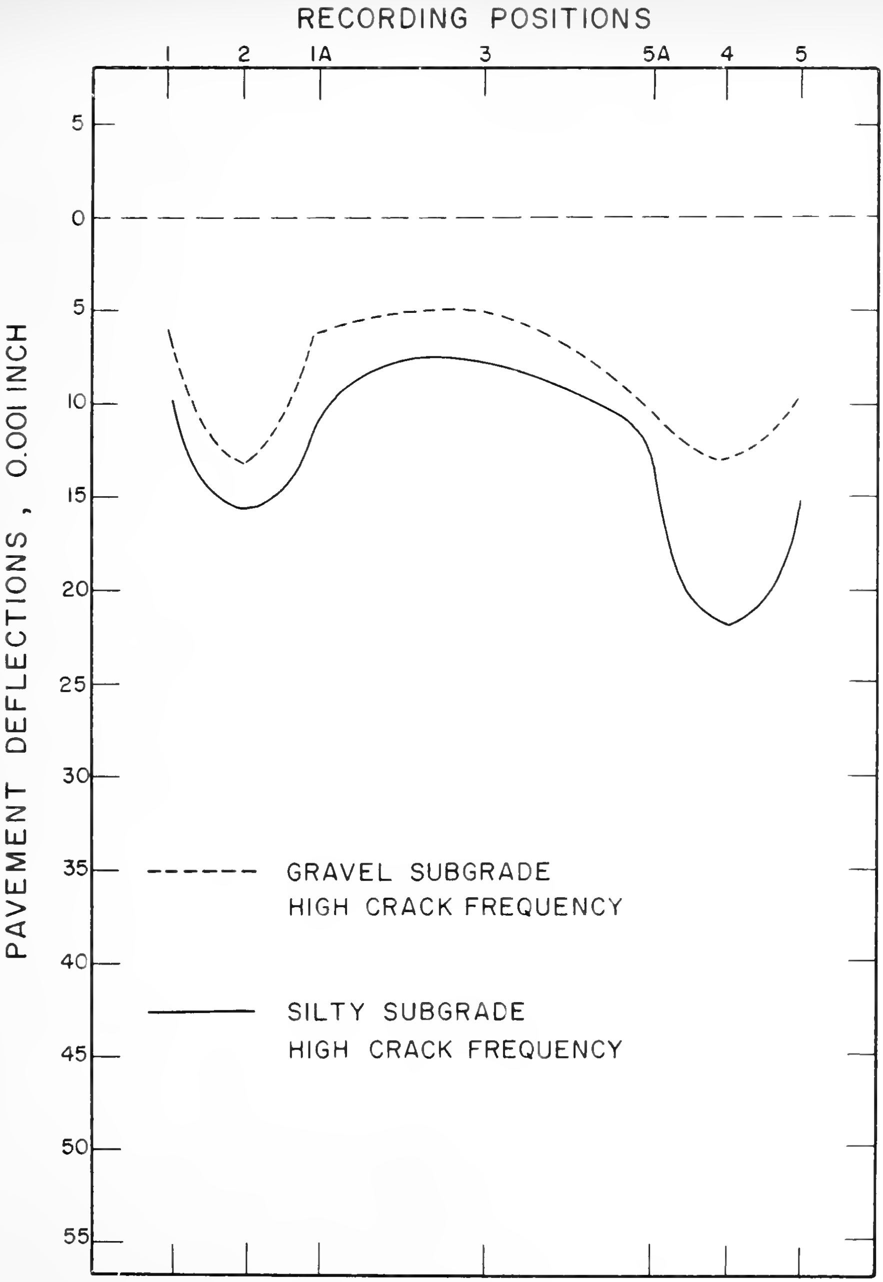
FIGURE 2

total load (which fix the radius), vertical deflection is dependent upon a settlement factor F which is in turn dependent upon the ratio of z/a. The above equation was developed using certain boundary conditions which will not be discussed here. Considering the theoretical or calculated values in Figure 2, depth of influence of deflection for various plate sizes is shown. For example, circular plates with large diameters cause greater depths of influence than those of smaller diameters. [illegible]

[illegible]

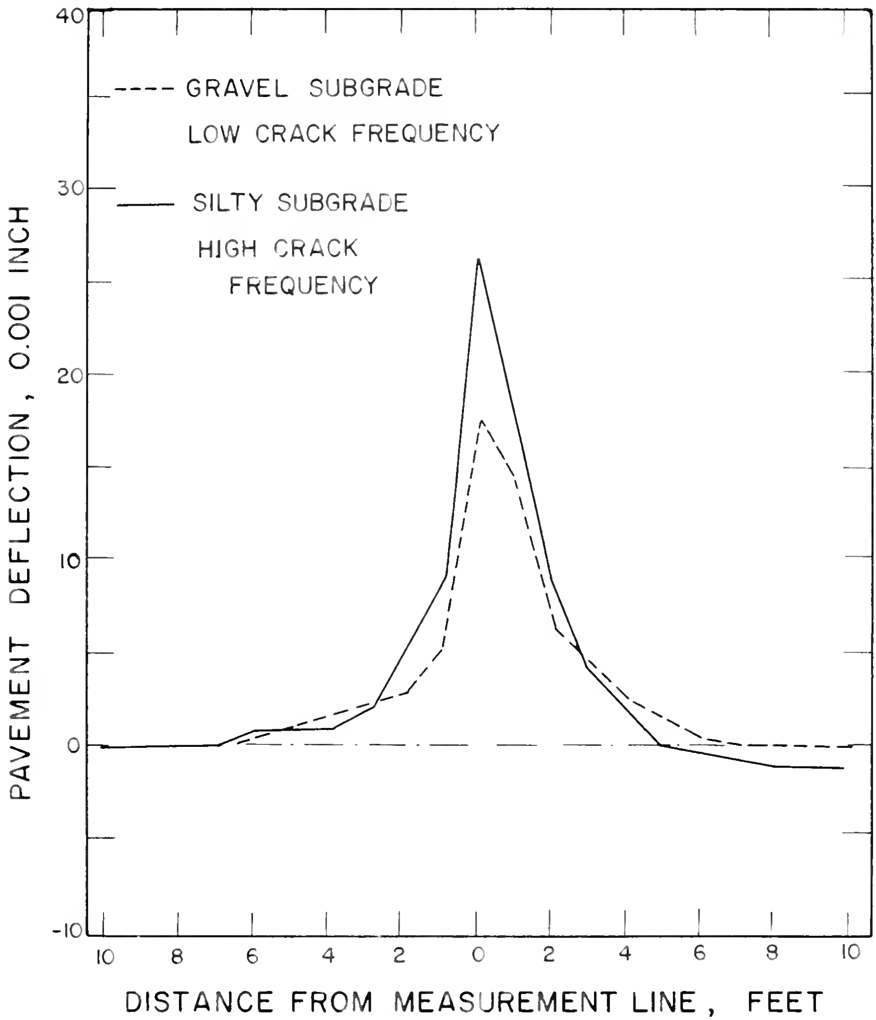
[illegible]

[illegible]



TYPICAL TRANSVERSE DEFLECTION CURVES

FIGURE 3



TYPICAL LONGITUDINAL
DEFLECTION CURVES

FIGURE 4

METHOD OF ANALYSIS

Several methods of analysis can be adopted; each of these will be discussed briefly in subsequent paragraphs.

1. Measurement of gross deflection.
2. Measurement of gross deflection along with measurement of the deflection of each component layer of the [illegible]
3. [illegible]
4. [illegible]
5. [illegible]

[illegible]

[illegible]

[illegible] subgrade. [illegible] resulted in less deflection [illegible]

No significant correlation was found between total deflection and wheel load frequency.

Figures 3 and 4 indicate an interesting feature of the deflection patterns. In each case the granular subgrade showed less total deflection than the silty subgrade. However, the radius of bending of the pavement built over the gravel subgrade was generally smaller than the radius of bending for comparable pavements [illegible] radii of bending [illegible] suggest that pavements [illegible] may be [illegible] than those with large radii of bending. Analysis of the data for the test road, however, did not indicate a significant [illegible] between radius of bending and pavement distress.

Use of unit deformations (deflection of the layer divided by the thickness of the layer) is subject to some restriction [illegible] dependent upon depth below the surface as well as type of material. Hence it becomes necessary to [illegible] unit deformations since they do not [illegible] any given layer of the pavement.

The [illegible] of analysis [illegible] materials. [illegible] (pavement [illegible]) [illegible] significant portion of the [illegible].

Figure 5 [illegible] and deflection. The [illegible] Figure [illegible] expression that [illegible] elastic [illegible]. [illegible] of analysis [illegible]

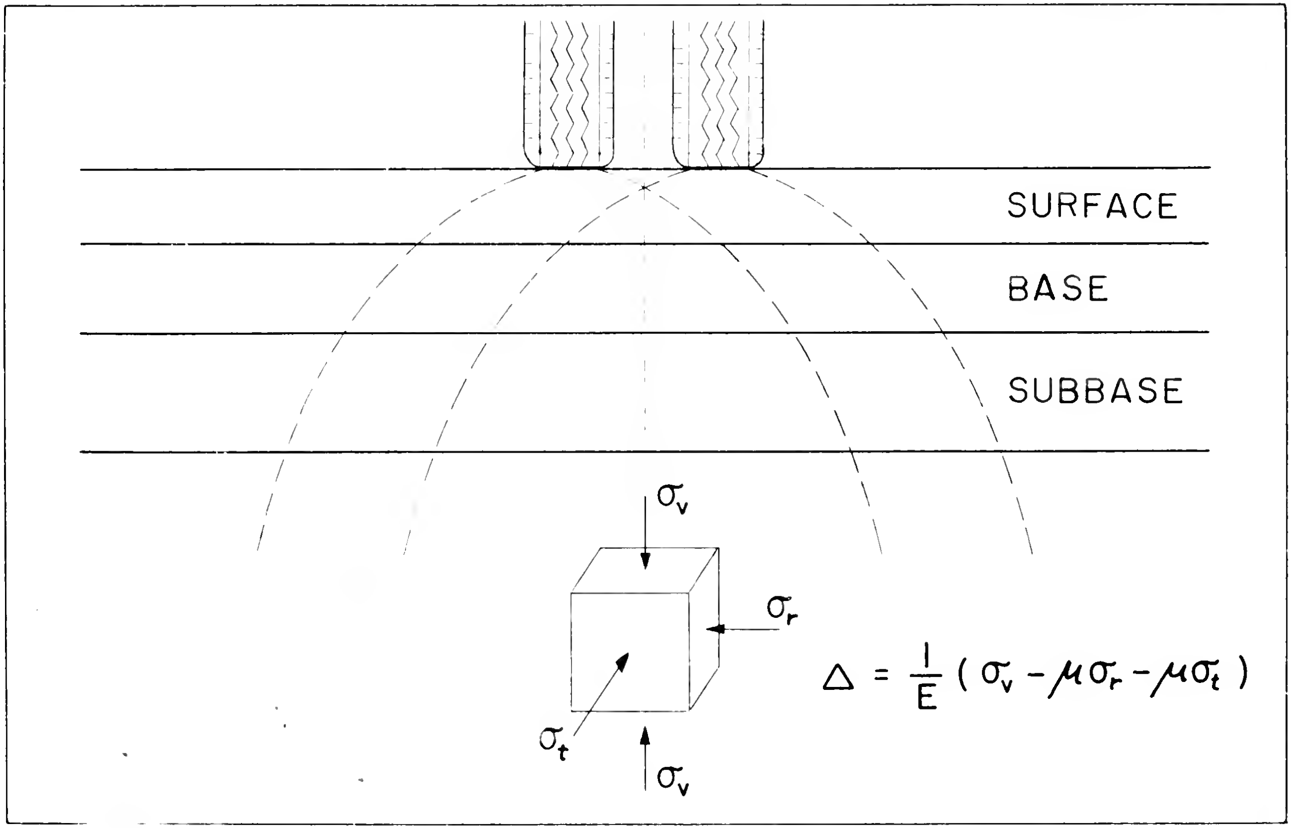

SURFACE
BASE
SUBBASE
σ_v
σ_r
σ_t
σ_v
$\Delta = \frac{1}{E}(\sigma_v - \mu\sigma_r - \mu\sigma_t)$

FIGURE 5

stresses [illegible] a simple method to [illegible] the modulus of elasticity. Unfortunately, this requires a great deal of instrumentation.

Figure 6 shows variation of vertical stress with depth as measured by pressure cells below a 12-inch crushed stone base course. Theoretical values of stress are also plotted against depth. [illegible] the stress pattern [illegible] component layers of a pavement it is necessary to use only change of stress with depth to assume an elastic condition, it appears that use of theoretical equations for estimating stresses is warranted.

[illegible] CHARACTERISTICS

Using the procedure [illegible] stress-strain [illegible] theoretical [illegible] significant differences in [illegible] values [illegible] components.

A research project was [illegible] whereby layer deflections were measured on the U. S. 51 Test Pavement using the Benkelman Beam. Figure 7 shows a diagrammatic sketch of this beam. The probe at the extreme left-hand side is placed between a set of dual wheels and then as the truck moves away from the probe, deflection is indicated by means of the dial on the right.

Figure 8 shows the set-up for measuring the layer deflections. The test pavement consists of asphaltic concrete, water-bound macadam and granular subbase resting upon the grade. Holes were drilled through the asphaltic concrete and plates were set on each pavement layer.

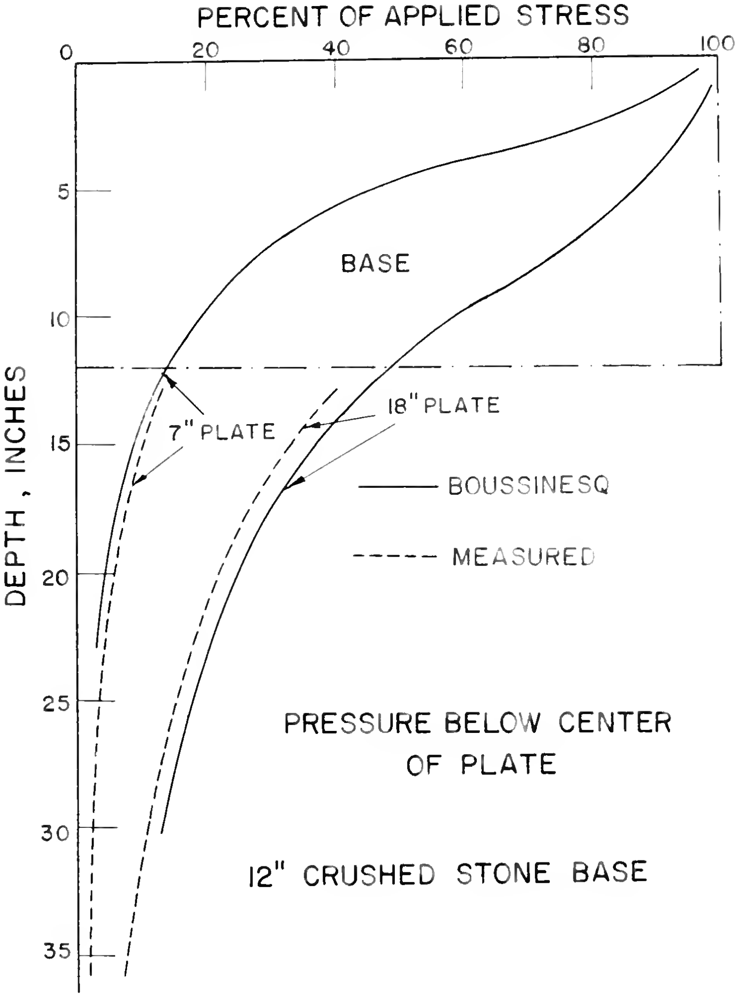
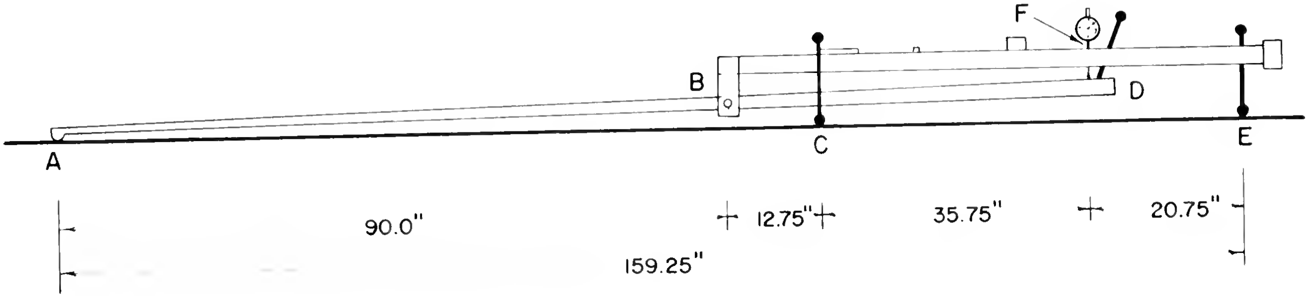

PERCENT OF APPLIED STRESS
0
20
40
60
80
100
5
10
15
20
25
30
35
DEPTH, INCHES
BASE
7" PLATE
18" PLATE
BOUSSINESQ
MEASURED
PRESSURE BELOW CENTER OF PLATE
12" CRUSHED STONE BASE

FIGURE 6



BENKELMAN BEAM

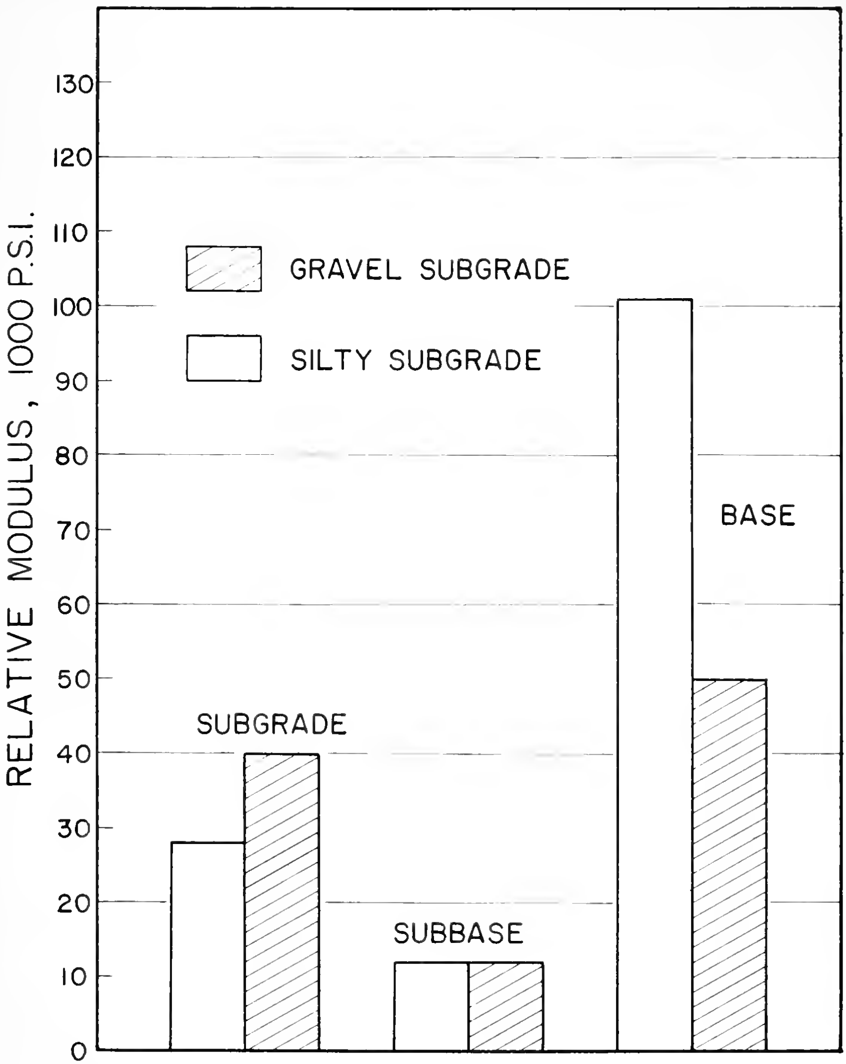
FIGURE 7

Figure 9 shows typical relative modulus values which were calculated for two locations. It was found that crack frequency could not be correlated with subgrade modulus values, but a relatively good correlation was established between crack frequency and surface [illegible] values. [illegible] Figure 9 it is seen that the [illegible] had relatively high modulus values whereas the modulus [illegible] the [illegible] in general [illegible] subgrade.

SUMMARY

The [illegible] structural performance of the pavement. [illegible] surface pavement deflection under various loading conditions for [illegible]. It has been the purpose of this paper to present [illegible] factors which [illegible] deflection measurements.

[illegible] values are influenced by [illegible] type [illegible] presence of [illegible] pavement [illegible] measurements [illegible] will be influenced [illegible] by type of [illegible] than other [illegible] of the pavement [illegible] deflection measurements [illegible]. This was brought out [illegible] on the U. S. [illegible] frequency could not be correlated with total deflection [illegible] of correlation was indicated between [illegible] and layer deflection. It was not possible to formulate definite conclusions relative to radii of bending as it affects performance; however [illegible] indicated that such a relationship should exist.



RELATIVE MODULUS OF PAVEMENT LAYERS
11250 POUND DUAL WHEEL LOAD

FIGURE 9

Previous paragraphs have shown theoretical relationships between deflection patterns and depth for relatively homogeneous [illegible] are also presented which indicate deflection patterns [illegible] measurement under prototype pavements. A marked degree of similarity is apparent when considering the theoretical and measured values. The results [illegible] deflection measurements have [illegible] of [illegible] each [illegible].

[illegible]

[illegible] overcome [illegible]